SCIENCE

VOL. 99 FRIDAY, FEBRUARY 4, 1944 No. 2562

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SCIENCE: A Weekly Journal devoted to the Advancement of Science. Editorial communications should be sent to the editors of SCIENCE, Lancaster, Pa. Published every Friday by

THE SCIENCE PRESS
Lancaster, Pennsylvania

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington 25, D. C.

THE ADVANCEMENT OF LEARNING IN THE UNITED STATES IN THE POST-WAR WORLD[1]

By Dr. JAMES B. CONANT
PRESIDENT OF HARVARD UNIVERSITY

IT is a great honor to have the privilege of giving the Franklin Medal lecture. The subject I have chosen is highly academic, but for this I offer no apologies to a distinguished audience. The matters which I shall treat are primarily of concern to scholars, yet, as I shall attempt to demonstrate, their implications affect the lives of all the citizens of this republic. And conversely, the attitudes and actions of the lay public will determine to no small degree the future of the world of scholarship. In short, my remarks to-night are in the nature of a footnote—an American footnote—to a discussion of the problem of the relation of society to scholarship, or, if you will, of the scholar to the nation.

[1] Franklin Medal lecture, given at the American Philosophical Society, Philadelphia, November 19, 1943, in a Symposium on the Organization, Direction and Support of Research. *Proceedings*, Am. Philos. Soc., Vol. 87, No. 4.

I

It is clearly impossible to discuss the advancement of learning in the United States without making some assumption as to what these United States will be like in the next two decades. For example, if by some miracle Hitler should succeed in forcing a stalemate, the omens would not be auspicious for the advancement of learning or for many other human activities—quite the contrary. We should be living in an armed camp, the authority of the Federal Government would be paramount and the national policy would be largely determined by military necessity. Except in certain specialized fields, knowledge would not advance. Similarly, if a period of social crisis were to be followed by a highly regimented society, the advancement of learning would soon fail to prosper. Under such conditions, whether the strong arm of govern-

ment were swung from the right or from the left, the effect would be the same; an official doctrine would cast an ominous shadow of fear over all discussion; dogma would take the place of free inquiry.

There is no need to labor the point. Those who have eyes to see or ears to hear know what has taken place across the oceans, and they tremble when they visualize the impact of society on science, or rather they tremble when they realize the effect of the impact of certain types of society on science and learning.

But history shows us that it is not only modern totalitarian societies which put learning in a straitjacket. There are insidious poisons which may arise from every pore of the social structure and without benefit of the police or a "party line" suffocate the human urge to know and to understand. I venture to remind you of Gibbon's classic description of the highly stratified society of Byzantium:

> They held in their lifeless hands the riches of their fathers, without inheriting the spirit which had created and improved that sacred patrimony: they read, they praised, they compiled, but their languid souls seemed alike incapable of thought and action. In the revolution of ten centuries, not a single discovery was made to exalt the dignity or promote the happiness of mankind. Not a single idea had been added to the speculative systems of antiquity, and a succession of patient disciples became in their turn the dogmatic teachers of the next servile generation.

If the United States of the 1950's and 1960's is on the road to a civilization like that of the Byzantine Empire or like that of certain totalitarian nations in the 1930's, there is no use in discussing the advancement of learning. For the phrase no longer has the meaning given to it by Francis Bacon; it no longer carries those implications which have raised the hopes of countless men and women who have echoed his words through more than three centuries of ever-increasing liberty.

There can be no escape from the conclusion that if we are to talk about the advancement of learning, we must postulate the continuance of a free society. Can we accept such a postulate for the United States in the years ahead? I believe we can without hesitation. I say this in spite of the apprehension of many (which I share) as to the effect of the trend of this century towards collectivism, a trend reinforced by the demands of war.

I make this confident assertion as to the continuance of a free society because I believe we shall win not only the present war but the subsequent second battle for freedom. This second battle for freedom will start when the military might of Germany and Japan has been overthrown. It will be a battle not of planes or tanks or ships, a battle not of men against men but of a nation against threatened calamity. It will be the fight of a free people to continue along their historic line of development, a free people committed to the ideal of a fluid society with equal opportunity for all. It will be a fight to maintain a truly competitive system based on individual initiative arising afresh in each new generation. It will be a fight to make a competitive capitalistic system work in spite of the complexities of modern industrial life —to make it work, furthermore, in the face of the apparently overwhelming obstacle of the demobilization of a military undertaking which staggers the imagination.

I believe we shall win this second battle for freedom by keeping our blood pressure down and our chins up; we shall succeed by continuing the spirit of national unity achieved in time of war, by putting the nation's welfare ahead of personal desires, by clear and quick thinking on the part of experts and leaders alike even in the face of what some may proclaim to be "imminent disaster." And I believe we shall come out of this second battle for freedom without having witnessed the violence of revolution or counter-revolution and without having broken the continuity of our tradition.

We in the United States are the heirs of both the American and the French Revolutions. Nowhere else in the world have so many men for so many years acclaimed the ideals which are expressed by such phrases as: "liberty, equality, fraternity" and "life, liberty, and the pursuit of happiness." Nowhere else in the world have the slogans, "equality of opportunity" and "there are no classes in this country," expressed national ideals from which few ventured to dissent. Yet all who are not vainly trying to live in a past century know the force of a terrible question which has been raised throughout the western world—the question, how can these democratic ideals be in fact made a reality for the many, when vast economic power is wielded by a few. We shall evade this question at our peril. For it is only by facing it squarely that we shall find the answer; and it is only by finding the answer that we shall evolve a uniquely American civilization which will be, indeed, the promised land for those who would be adventurous and free.

II

Free inquiry—these words sum up, as well as any, the necessary condition for the advancement of learning in any age. The scholar must be free. He must be free both from intimidation and from control by government. He must inquire and speculate with as few restraints as possible. Yet history shows that the advancement of learning has not proceeded in a social vacuum. In those times when the advance has been

most spectacular, when groups of eager young men pressed forward in a new direction, there were strong forces at work which determined to some degree the objectives on which men of learning set their eyes. No one familiar with even the outlines of the record of the advancement of learning in the last three centuries can doubt that fact.

A controversy has been in progress during the last decade, however, as to the variety and kinds of social forces which have conditioned the behavior of scientists and scholars. This controversy stems from the application of the orthodox Marxist doctrine to a historical problem, namely, the relation of science to society. According to the Marxist view, "science is the product of the economic conditions of society, and its social function is to benefit the ruling classes of society." When applied to the work of Sir Isaac Newton, for example, this interpretation of the past leads to the somewhat startling statement that "Newton was the typical representative of the rising bourgeoisie, and in his philosophy he embodies the characteristic features of his class." Furthermore we are asked to believe that the scheme of physics with which he was concerned "was mainly determined by the economic and technical tasks which the rising bourgeoisie raised to the forefront." And the proponents of this twentieth century doctrine are ready to laugh out of court any who prefer a more heroic reading of the history of science; they will throw in their faces with a jeer Pope's famous lines:

> Nature and Nature's laws lay hid in night;
> God said "Let Newton be!" and all was light.

But the sin of oversimplification may not lie entirely with the eighteenth century poet. This is made evident by a critique of the Marxist position from the pen of a distinguished historian, Professor G. N. Clark, in a small volume on "Science and Social Welfare in the Age of Newton." But the discussion continues. Two brilliant scientists of Great Britain line up on opposing sides. Bernal's "The Social Function of Science" is answered with vigor by Polanyi's "The Rights and Duties of Science" in his book, "The Contempt of Freedom."

As one interested in the history of science, I hope the debate will continue. But it seems evident that the economic interpretation of the history of science no less than the economic interpretation of general history can be pushed to absurd and extravagant lengths. The progress of pure science, for example, has been clearly in part a response to utilitarian stimuli. However, it is easy to show that this is not the whole story. Even the relation of science to industry, for example, is a highly complex affair. As I suggested here in Philadelphia last winter, neither the scientist nor the industrialist has been a parasite, the one living on the other. Rather, we are dealing with a case of symbiosis. If this be so, the healthy advance of physics and chemistry in the future will be assisted by a clear recognition of the symbiotic relation which these sciences bear to progress in technology.

Even when we consider only the field of experimental science, it seems evident that social forces other than economic have played an important role in relatively recent times. For example, the foundation of the Royal Society was closely connected with English Puritanism during the Cromwellian period. One can even make a very plausible case, following the lead of Max Weber, for a relationship of cause and effect between dissenting protestantism in general and the urge to follow Bacon's advice and advance learning for both godly and material reasons.

If the scientific movement in England in the seventeenth century came largely from dissenting and rebellious quarters, English scholarship in the field of history after the Restoration was the beneficiary of the opposing current of orthodoxy and loyalty to the Sovereign. A concern for the historical foundation of the Anglican church and doctrines led a number of ardent royalists to become great scholars. But this type of motivation is, of course, a recurrent factor in the history of scholarship. From the Middle Ages until the eighteenth century, theological controversy, philosophical inquiry, and the study of antiquity were almost inseparably interwoven.

In short, as we view the advancement of learning over a considerable span of time, the ivory tower seems conspicuous by its absence. The scholar may imagine that he is as free as a pioneer in a virgin forest, yet those who trace his wanderings from a distance can discern the effect of many varied social forces. Indeed, it would be my contention that certain types of strong social forces must play upon the world of scholarship if the spirit of learning is to live and flourish. Paradoxically, free inquiry must be powerfully polarized if inquiry is to prosper. This will be particularly true, it seems to me, in the highly industrialized age which lies ahead. For if free inquiry is but an aimless, leisurely ramble amidst delightful scenery, it is likely to become an occupation only for the old and intellectually infirm.

Professor Bernal warns that "whatever the scientists themselves may think, there is no economic system which is willing to pay scientists just to amuse themselves." I am not so sure. The cost accounting methods of a democracy are not as penetrating as he assumes. But I do feel sure that if one attempts to justify a scientific or scholarly activity solely in personal hedonistic terms, the effect on the incoming recruits will be disastrous. Is it not clear that if scholarship and pure science are to flourish in a democratic,

technical society, such enterprises must be alive and vigorous? Is it not evident that they must be a part and parcel of the great adventure of the day? Only then will the ambitious, energetic, and imaginative young men of each generation be attracted to the academic and learned world. And it is on the recruitment of the next generation of scholars, I may remind you, that the future of each age of scholarship depends.

From all this I am sure no one in the audience will dissent. A debate might well develop, however, if we were to try to distinguish more closely between those forces which may polarize the field of learning disadvantageously and those which are beneficial in their action. The Marxists among you, if there be any, would certainly make free use of the idea of social utility and would not be too much worried if society rather frequently demanded an accounting from the scholar in those terms. Others among you would both repudiate the validity of the test of utility and be shocked by any suggestion of an accountability of the world of scholarship to those who stand outside.

Personally, I view the question not primarily in terms of the degree of coercion of the scholarly by the masses; but rather as a problem involving the quality of the appeal that the scholar can make to the brilliant and enterprising sons and daughters of those who constitute the masses. And I think this appeal should be couched neither in utilitarian terms nor in those appropriate to a secluded retreat where the academic equivalent of the slogan, "art for art's sake," is the official doctrine. Rather, it seems to me that in each area of the entire field of learning the activities under way must be manifestly relevant to the future of our civilization. The undertakings must be relevant not only to man's physical and social needs but to his highest hopes and aspirations. Relevance, not utility, therefore, I submit is the touchstone to test the vitality and validity of a scholarly enterprise—relevance to the future as we envision it.

III

To illustrate how the relevance or lack of it in scholarly undertakings may be assessed, it is essential to deal separately with widely different types of intellectual activity. For this purpose the conventional academic divisions are quite unsuitable. Therefore, I propose to follow Francis Bacon in trisecting the whole field of learning, but to take great liberties with his definitions.

In the second book of the "Advancement of Learning," Bacon wrote as follows: "The parts of human learning have reference to the three parts of man's understanding, which is the seat of learning: history to his memory, poesy to his imagination and philosophy to his reason."

Three centuries of the very activity for which Bacon was pleading throughout his famous treatise have made his classification now inadequate. In the twentieth century we have a vast fund of knowledge accumulated by the labors of historians, archeologists, experimental scientists and observers of natural history. We roam freely in fields of which the author of the "Advancement of Learning" never dreamed. And we are confident that the process of expansion has far from reached the end. With Mr. Churchill we can believe that "the empires of the future will be empires of the mind."

Looking back over the journeys of the pioneers who opened the new vistas for us, we can speak with assurance of the advancement of learning. Indeed, here and there we can even hazard an opinion as to the rate of progress and complain about those times and places when it seems unduly low. Seen in historical perspective, many products of man's memory and reason must be classified together. From this point of view the labors of a dozen generations of experimental philosophers are clearly more closely related to archeology than to what is now embraced by the term philosophy. Mathematics, likewise, has undergone a similar development.

Bring back to life a student of antiquity of a century or two ago and confront him with the present status of archeology and ask him whether or not learning has advanced. Can there be any doubt as to his answer? Repeat the hypothetical operation in physics or biology or mathematics and ask the early investigator whether or not he would have counted himself blest by fortune if he could have stood where his successor stands to-day. I may remark parenthetically, that this imaginary operation can be performed with considerable assurance, using much shorter intervals of time and more restricted areas of interest. By so doing one can give meaning to the word progress as applied to intellectual undertakings.

We would do well, therefore, to merge portions of Bacon's two classes (his first and third), history and philosophy, into one which we may designate "accumulative knowledge." In this area we can speak of the advancement of learning and indeed apply such tests as I have suggested to see whether or not learning has advanced over the course of the last few generations. We can even estimate the chances of further rapid progress on a given restricted front. And such estimates are of profound significance in regard to this question of the relevance of scholarly activities. For in a free democratic society dedicated to the preservation of the dignity of the individual, I believe a true advance in learning will always be considered relevant. Quite apart from any idea of utility (however we stretch the word), I am convinced that intelli-

gent men and women in the sort of America I have dared envisage for the 1960's will be ready to cheer each new step forward; they will be ready to acclaim the acquisition of new territory by the "empires of the mind."

But let us be quite certain that we do not mistake the mere acquisition of information for an advance in knowledge. For the piling up of new facts may or may not be relevant to future intellectual progress or to society's needs. All who are familiar with the history of the physical sciences know that there has been a tremendous amount of thrashing around in the underbrush even during those times when giants were hewing out dazzling paths through the virgin forests. Or to vary the metaphor, we are all aware of how many scholars have continued to dig assiduously but unprofitably in exhausted mines. All of which is inevitable and trivial except when loyalties and traditions urge men to claim either that digging is a worthwhile activity in and for itself, or that the yield from an exhausted vein is full of gold.

It is at this point that the argument between "science for science's sake" and social utility begins. It may soon degenerate into an argument for the continuation of a particular line of intellectual activity merely because this has once been a fruitful direction of adventure. The argument soon becomes an emotional defense by those who love the field in question and who endeavor to support their loyalty by an appeal to general principles of the sacredness of all knowledge. At this point young scholars start leaving the academic halls. Society becomes impatient. And rightly so.

IV

Let me now turn from the first category—accumulative knowledge—to the other two which, following Bacon closely, I shall designate as poesy or, if you prefer, poetry and philosophy. Whereas the idea of progress is both valid and significant in the first category, accumulative knowledge, in the other two the concept is not only invalid but a positive deterrent to relevant undertakings. And at this point, lest all but scientists, mathematicians and archeologists leave the room in protest, I hasten to assert that I place no halo over the word progress. There is no hierarchy implied in my classification.

Indeed, any one who wished to give poetry or philosophy an inferior place as compared to accumulative knowledge would soon find himself in an untenable position. For it is obvious that poesy or poetry on the one hand and philosophy on the other together hold the keys to man's immediate future, including the future of the advance of accumulative knowledge. That this is so, current history provides ample proof. Nazism triumphed in Germany not because the Germans were lacking in power to advance learning but because bad poetry and a wrong philosophy prevailed. Remember that unless we are to have a free society there will be little chance for progress in understanding the world of animate and inanimate nature in which we live. And yet this progress or the lack of it will affect only slightly the freedom or the lack of it in the United States in the postwar years. On the other hand, the ideals, the hopes, the ambitions as well as the doubts, the anxieties, and the fears of millions of men and women may well prove decisive. And these thoughts and emotions are largely conditioned by the poetry and philosophy of the day.

There are countless vexatious questions which must be daily answered by each of us as individuals and collectively as a nation, and for which there are as yet no answers provided by our fund of accumulative knowledge. Considerable nonsense is often talked about applying the scientific method to social problems. What is this scientific method? The usual philosophic inquiries into the question seem to me a bit unreal when one surveys the range of methods actually employed by sciences as remote from each other as geology, systematic botany, organic chemistry and mathematical physics. Perhaps science is after all only organized common sense, preferably derived from experiment and preferably organized on a quantitative basis.

Perhaps by the scientific method one means only an impartial examination of a situation, an honest attempt to use rational powers to analyze complexities. If so, the phrase is badly chosen. It blinds us to an important distinction between situations where value judgments are by necessity involved and those where they can be eliminated from the frame of reference. Only in the latter case are methods comparable to those used in the advancement of knowledge really applicable. Yet the difference between disciplined and well-informed judgments involving values on the one hand, and on the other extravagant and ignorant opinions, is the difference between civilization and barbarism.

One of the chief ends of education is surely to develop the capacity for making civilized judgments on all those matters of value which are involved in so many vital human decisions. Such judgments can be illumined often by our knowledge of the past experiences of the race, but they are largely determined by emotional reactions and channels of thought whose pattern by necessity varies from age to age. It is thus the poetry and philosophy of the present, rather than accumulative knowledge, which play the significant role in outlining the next act in the drama of world history.

If we use the term poetry to cover all creative insights into human destiny whatever their form may be, and the word philosophy to include the whole expanse of analytical and speculative thought except for mathematics and the sciences, we see that many aspects of a scholar's labors fall within these bounds. Together with accumulative knowledge these two classes comprise the field of secular learning. All matters closely related to religious faith must form a fourth category. With their relation to society and the scholar, I do not propose to deal to-night. For, in the phraseology of Bacon, I am not trespassing on the field of divine learning, but confining myself entirely to that of human learning.

With this limitation, all the usual fields of scholarly activity are included in the three categories I have named: accumulative knowledge, poetry and philosophy. Many cut across two and even all three. For example, history as an interpretation by the present of the past must rest on accumulative knowledge, but consciously or unconsciously reflect the philosophy of the writer; and it has been said more than once that every great historian is not only a historian but a poet. In general, the humanities and the social sciences, to use our modern terms, cut across all three fields, and only rarely does the major part of a traditional subject fall within the boundaries of accumulative knowledge. For this reason it would seem a grave error to treat these disciplines as though the increase of accumulative knowledge (an advance in learning) were the significant aspect of the undertaking. Only in a very few instances is that true to-day, in my opinion.

The significance of poetry and philosophy is not to be measured in terms of progress or advance. Try, for example, my imaginary operation of bringing back to life great figures of the past. We can hardly doubt how Galileo, Newton, Harvey or Winckelmann would respond to a glimpse at the contemporary answers to the questions which they raised. It is far otherwise with Michelangelo, Rembrandt, Dante, Milton or Keats. It is far otherwise with Thomas Aquinas, Spinoza, Locke or Kant. You and I might argue until midnight whether or not the particular artist or poet or philosopher would feel that the present state of art or poetry or philosophy was an advance or a retrogression from the days when he himself was a creative spirit. There would be no unanimity among such an audience as the one I am addressing to-night; and more significant still, no agreement between the majority view which might prevail here and that which would have prevailed in a similar gathering half a century ago.

We are not dealing with accumulative knowledge when we speak of poetry or philosophy. We are dealing with something far more vital, in a sense far more practical; something that affects for better or worse the ambitions and the conduct of civilized man. The advance of learning is here a trivial matter; relevance is tested by the ordeal of battle. New disciples will flock to those masters who sit not in an ivory tower or with their vision fixed on a by-gone day, but who endeavor to understand and interpret the scene that unfolds year by year before their eyes; or to those others who, alive to the significance of the present, seek to bring nourishment and enlightenment from the wisdom of the past.

It has been well said that a poet's garden should be not in the market place but hard by. By the same token, a university—the home of scholars—should be bounded by both the market place and the poet's garden. This location presupposes, of course, that there will be ample opportunity for communication over the academic walls. The philosophers and those who seek to advance learning, I assume are largely academicians. How much they should also be either poets or active in the market place is an open question. As far as the accumulation of knowledge is concerned, the problems involved are rather superficial. The relation between pure and applied science can be adjusted with little difficulty and to the mutual advantage of both the progress of science and the welfare of society.

The same is true of those aspects of social science which are clearly concerned with accumulative knowledge. But when we come to the more usual case, where large elements of philosophy and some poetry are admixed, the situation alters. Since the relevance of such undertakings depends on their relevance to the ideals of the future which arise from the maelstrom of the present, one can maintain that the social philosopher must travel constantly between the market place or forum and the academic halls.

On the other hand, a well-known economist has expressed the view that

> the service of social science and the practice of the arts of democratic government are vocations each of which may be pursued with sincerity and singleness of purpose, but they cannot be combined. A social scientist cannot become a politician by speech or writing or affiliation without losing value as a scientific investigator and a teacher. Without derogation from essential academic freedom, those who choose the academic vocation in the social sciences should impose on themselves reticences and self-denials in the political and practical field, which would not be necessary for teachers of other subjects, but are necessary to give to the social scientist that emotional detachment from his subject which comes naturally to the biologist or chemist.

It may be a surprise to many to learn that the au-

thor of these words is Sir William Beveridge. The quotation is from his farewell address to the London School of Economics in June, 1937. The sentiments expressed are directly contrary to what is current practise both here and in Great Britain. Which view is right?

I wonder if the answer is not to be found in the distinction I have endeavored to maintain between accumulative knowledge and philosophy. If we call those whose aim it is to advance learning scientists (though this is bad nomenclature), then if a professor wishes to be a social scientist he may well follow Beveridge's admonition. If, however, he is a social philosopher and wishes his thinking to be germane to the problems of the day, he can hardly fail to become identified with politics from time to time—that is, he will take a position that results in his being affiliated in the public eye with an issue which has become political. In a sense he is an applied scholar and his political activity is as much a measure of his stature as the corresponding field activities of an applied scientist or engineer.

The difficulties seem to me to arise primarily because confusion reigns over what is social science and what social philosophy. Or, perhaps, more often the confusion arises because a given professor endeavors to be at the same time a social philosopher and a social scientist. I think the academic world needs both; but I doubt if they can be combined in a single individual for the reasons Sir William Beveridge has pointed out. Furthermore, I think the distinction between the two types of individuals might well be made explicit with advantage to both the public and the universities.

I have assumed that a major share of both advancing learning and fostering philosophy will be the responsibility of the universities in the years ahead. Research institutes will, of course, also play an important part, particularly in the applied sciences including medicine. But by and large the more fundamental the scholarly or scientific work, the more difficult it is to provide for it in advance. The exceptional man turns the unexpected corner in ways which can not be foreseen. No one can designate the targets in advance. This fact makes difficult the organization of research even in applied fields. It practically makes impossible the planning of research in other areas. The scholar must be a free agent and may or may not be productive. This being the case, it is unlikely that society will foot his bills: hence a larger share of scholarly undertakings must be coupled with another activity, namely, professional teaching. And the organization of our universities must be kept as flexible as possible if they are to serve the nation as they should. Whenever we are fortunate enough to see a man of genius emerging, he should be given the greatest possible scope within a university. The usual academic compartments should not confine him either in his relation to the students or to the investigation which he has in mind.

Our scholars will be teachers. I except only the fields of applied science, including medicine. I base this prophecy on the past history of the methods by which society has supported the advancement of learning even in times of unqualified enthusiasm. But whether or not the combination of professional education with scholarly endeavors is the most likely way of financing the latter, is it not essential that our intellectual leaders be in close contact with the most promising youths of the uncoming generation? There is no other way in which we can be certain that the current of intellectual adventure will continue to flow vigorously ahead.

In the United States we have many different types of institutions of higher learning. This is fortunate for several reasons. In the first place, we can rest assured that only drastic action could enforce a regimentation. In the second place, the number and variety of our universities spell assurance that there will be intensive competition. This in turn means we shall continue to provide adequately by one means or another for exceptional scholars and brilliant teachers. These two advantages are great, indeed, and far outweigh the evils inherent in the inchoate educational system which to outsiders seems often both inexplicable and thoroughly unsound.

The great flame of war which has seared all of Europe places heavy responsibilities in our hands. A large share of the future of the scholarly activities of the world must be carried on in the next decade on this continent. To meet this challenge we need invoke no powers of the Federal government, nor embark on a vast program of building special institutes for scholarly undertakings. We need not organize into a hierarchy our institutions of higher education. We need only make certain that to foster the spirit of free inquiry shall be an ambition of the American people. We need ask only that the nation support our diversified American universities, not only as educational institutions but as communities of scholars. If the response be favorable, for the rest we need have no fear.

V

Now in conclusion, may I say just a word in answer to the obvious criticism that in trisecting the field of intellectual activity in a new and arbitrary fashion I have destroyed the unity of the ancient society of scholars. To my mind, the unity of the world of pure learning (including science, philosophy and

as much of poetry as the writers, artists and poets will allow) is based not on a common method but on a common motivation. Perhaps, I should rather say dedication. For the scholar, the seeker after truth, whether he be mathematician, archeologist, scientist, philosopher, poet or theologian, must come into the court of public opinion not only with clean hands but with a consecrated heart. He must have integrity of purpose, a disciplined imagination and the power of critical analysis both of the problem at hand and his own contributions. In addition he must have high standards of performance as to the technical aspects of his task.

His rewards are not measured in terms of material riches or the satisfactions which to many men are most enduring. For him neither wealth, nor power; neither the happiness which comes from contributing immediately to the public welfare, nor the exhilaration of being one of the builders of an expanding industrial age. Unlike the applied scientist or the social philosopher who is in the arena of active life, he will know little of the extremely unscientific problems involved in the management of men. His ambition as a scholar, a philosopher, or a poet will be merely to seek the truth with all the skill and power at his command. This he will do humbly and yet with joy and pride. For without exalting his calling above that of others, he may nevertheless hope that from his labors will issue something that the "world may not willingly let die."

OBITUARY

RECENT DEATHS

DR. ARTHUR J. TIEJE, professor of geology at the University of Southern California, died on January 25 at the age of fifty-two years.

DR. CHARLES HASKINS TOWNSEND, from 1902 to 1937 director of the New York Aquarium, died on January 28 in his eighty-fifth year.

FREDERIC WILLIAM TAYLOR, of Los Angeles, the agriculturist, died on January 12 in his eighty-fourth year.

SIR JOHN BRETLAND FARMER, botanist, a former director of the biological laboratories at the Imperial College of Science and Technology, London, died on January 26 at the age of seventy-eight years.

A CORRESPONDENT writes: "A 1943 issue of the *Bulletin of the Academy of Sciences U.S.S.R.* (Department of Technical Sciences) recently received in this country carries an obituary of Professor Sergei Alekseevich Chaplygin, member of the Academy of Sciences, who died at the end of 1942 at the age of seventy-three. Professor Chaplygin, has been the head of the Research Institute of Aviation since 1921. He is credited with important research in theoretical mechanics and aerodynamics, beginning with the development of formulas for calculation of forces acting on airplane wings in 1910. He was decorated several times by the Soviet Government. His collected works were published by the Academy of Sciences in 1933-1935, and a second complete edition has been ordered by the Soviet Government and is in preparation at the present time."

SCIENTIFIC EVENTS

THE DELHI MEETING OF THE ROYAL SOCIETY

FOR the first time since its formation in 1662 the Royal Society on January 3 held a meeting outside England. This opportunity arose, according to *The Times,* London, from the presence in India of Professor A. V. Hill, who, acting for the occasion as vice-president, convened a short session of the Royal Society, before the opening of the Indian Science Congress by the Viceroy, Lord Wavell, at the University of Delhi. *The Times* writes:

Professor Hill explained that before leaving London he had been asked by the president and council of the society to convey by this means their greetings and good will to the scientific men and women of India, and he pointed out that, although most of those present were for the moment guests, there were a few fellows among them, and the King, patron of the Royal Society, was directly represented by the Viceroy.

As already reported Professor Hill's visit to India is closely connected with the scientific aspects of the war effort. He read to the assembled Indian scientists messages of greeting from the Prime Minister and General Smuts, and from British scientific bodies, and after his address two Indian fellows of the Royal Society, Dr. H. J. Babha and Sir Shanti Bhatnagar, who have not had the opportunity of being formally admitted, signed the traditional obligation on a sheet of parchment which will be inserted in the society's charter book. Lord Wavell then declared the Indian Science Congress open.

Professor Hill read the following message from Mr. Churchill: "It is the great tragedy of our time that the fruits of science should, by monstrous perversion, have been turned on so vast a scale to evil ends. But that is no fault of science. Science has given to this generation

the means of unlimited disaster or of unlimited progress. There will remain the greater task of directing knowledge lastingly towards the purposes of peace and human good. In this task the scientists of the world, united by the bond of a single purpose, which overrides all bounds of race and language, can play a leading and inspiring part."

THE NATIONAL RESEARCH COUNCIL OF CANADA

ACCORDING to an official release of the Canadian National Research Council, scientific research in Canada probably reached the peak of its contributions to the Armed Services in 1943. Based on the solid foundations built up with care in the two decades between 1918 and 1939, research activities in the Dominion were directed at once on the outbreak of the present war to the solution of many novel scientific problems arising from the new methods of warfare—mechanization on the ground, new types and tactics in aviation, advances in antisubmarine devices and operation. Now, in the fifth year of the war, Canada has an enviable record of accomplishment in the application of science to war needs.

The National Research Council is serving as the central coordinating body directing scientific research in Canada. Research in its own laboratories and in the universities and industry is a combined effort at present being directed to the solution of new and urgent problems arising out of the war. The council has been appointed the official research station of the Navy, Army and Air Force in Canada. Close cooperation between service personnel and research staff has been a large factor in the successful application of science to the solution of military problems.

Work is planned along two main lines; the conduct of fundamental and applied research, including essential test work in the National Research Laboratories in Ottawa, and the promotion, coordination and support of research in other centers throughout the Dominion by grants-in-aid, award of scholarships and the direction of research investigations under the guidance of committees of specialists appointed by the council. Effective liaison is maintained with scientific work going on in Great Britain, Canada, the other Dominions and the United States through the exchange of publications and the interchange of research workers.

Scientific problems referred to the council in connection with the activities of the Armed Forces are studied jointly by officers from Defence Headquarters and civilian personnel on the council staff. Decisions can thus be taken promptly and work started without delay. Many of the problems relate to the supply of materials and the preparation of specifications.

Much of the work of the council is carried on through committees. There are now some forty active committees working under its auspices. Important developments of special interest, because of their contributions to the health and well-being of both civilians and members of the fighting forces, are the committees on medical research. The original purpose of the Associate Committee on Medical Research is to coordinate medical research in Canadian institutions and to assist in its development. The work of this committee is now wholly directed to war problems. Three Service Committees have been established: First, Aviation Medical Research; then Naval Medical Research, and last year, Army Medical Research. The closest cooperation is maintained in all fields. Another important war-time committee of the council has directed and coordinated research in Canadian universities on sixty projects dealing with problems on the production of explosives now in use, and the development of new explosives.

Continuing its established practice the council has provided assistance to postgraduate research students in science and has made grants-in-aid of research for special investigations in the universities.

FUNGUS INFECTIONS

THE following announcement has been sent to the heads of departments of tropical medicine in the medical schools of the United States and Canada:

The group of workers studying fungus infections at Duke University has received a grant from the American Foundation of Tropical Medicine for the purpose of acting as a diagnostic and registry center for the fungus diseases of man.

The service may be outlined as follows:

(1) Identification of fungi already isolated from patients suspected of having fungus disease.

(2) Pathologic study and registry of biopsy and autopsy materials from patients suspected of having fungus infection. (This is not to conflict with the diagnostic and registry services maintained by the several branches of the armed forces.)

(3) A complete set of cultures of pathogenic fungi will be sent on request to any medical school for use in teaching courses in tropical medicine. To guarantee arrival of the fungi in proper state for study, it is necessary that requests for this material be sent at least one month prior to the time that the cultures will be necessary for demonstration.

By special arrangement: (a) Serologic tests will be made in certain of the fungus infections; (b) vaccines for skin testing and therapeutic use in certain of the fungus infections will be sent upon request.

Specimens for pathologic study should be sent to Dr. Roger D. Baker, Duke Hospital, Durham, N. C. All other requests will be handled through the office of Dr. D. T. Smith at the same address.

THE STEVENS RESEARCH FOUNDATION

ORGANIZATION of the Stevens Research Foundation, a non-profit corporation for scientific and industrial

research and related educational purposes, was announced on January 21 by Dr. Harvey N. Davis, president of the Stevens Institute of Technology, at the forty-first annual dinner of the Alumni Association. The foundation, which will carry on its work in cooperation with the college, aims to help to meet the new demands of the reconstruction era, including new products, new uses for old products and new and improved manufacturing processes.

In a statement made by Dr. Davis, he said:

> The research activities of Stevens have grown to such proportions that they merit an administrative set-up separate from that of the undergraduate college. All our present special research laboratories will be conducted by the new foundation. Close relationships will be maintained between the college and the foundation and their faculty and staffs—between the teaching and investigative functions.

He said that the first concrete projects to be undertaken will include powder metallurgy, towing tank and sound research, all already existing or in process of planning.

Dr. Davis, who is director of the Office of Production Research and Development of the War Production Board and who recently returned from a war mission to England, has been elected president of the trustees of the foundation.

The other trustees are Dr. Robert Crooks Stanley, president of the International Nickel Company of Canada, Ltd., and chairman of the board of trustees of Stevens Institute; Robert Cox Post, president of Post and McCord, Inc., and chairman of the executive committee of the trustees of the college; Willis Horr Taylor, Jr., member of the law firm of Pennie, Davis, Marvin and Edmonds; Charles Engelhard, president of Baker and Company, Inc.; George L. Morrison, president of the General Baking Company of New York, and James Creese, vice-president of Stevens Institute. All are trustees of the college. Mr. Post will serve as vice-president of the foundation, Mr. Taylor as secretary and Mr. Creese as treasurer.

THE WASHINGTON ACADEMY OF SCIENCES

OFFICERS of the Washington Academy of Sciences for 1944 have been elected as follows:

President, Clement L. Garner.
Secretary, F. G. Brickwedde.
Treasurer, Howard S. Rappleye.
Vice-presidents representing the affiliated societies:
Philosophical Society of Washington, Harold F. Stimson.
Anthropological Society of Washington, T. Dale Stewart.
Biological Society of Washington, Harry B. Humphrey.
Chemical Society of Washington, Edgar R. Smith.
Entomological Society of Washington, Austin H. Clark.
National Geographic Society, Alexander Wetmore.
Geological Society of Washington, Herbert Insley.
Medical Society of the District of Columbia, Fred O. Coe.
Columbia Historical Society, Gilbert H. Grosvenor.
Botanical Society of Washington, L. Edwin Yocum.
Washington Section of the Society of American Foresters, William A. Dayton.
Washington Society of Engineers, Frank B. Scheetz.
Washington Section of the American Institute of Electrical Engineers, Francis B. Silsbee.
Washington Section of the American Society of Mechanical Engineers, Walter Ramberg.
Helminthological Society of Washington, Emmett W. Price.
Washington Branch of the Society of American Bacteriologists, Ralph P. Tittsler.
Washington Post of the Society of American Military Engineers, William N. Corse.
Washington Section of the Institute of Radio Engineers, Herbert G. Dorsey.
Washington Section of the American Society of Civil Engineers, Owen B. French.
Elected members of the Board of Managers for a term of three years, Henry G. Avers and Francis M. Defandorf.
Elected member of the Board of Managers for a term of one year, William A. Dayton.

THE BOTANICAL SOCIETY OF AMERICA

AT a business meeting of the Botanical Society of America, Inc., held at the New York Botanical Garden on January 8, new officers were elected and general business transacted. The newly elected president is Dr. Gilbert M. Smith, of Stanford University. Dr. Paul Weatherwax, of Indiana University, was elected vice-president, and the new treasurer is Dr. George S. Avery, of Connecticut College. Dr. Edmund W. Sinnott, of Yale University, was elected to the editorial board of the *American Journal of Botany,* Dr. A. J. Eames, of Cornell University, is the new representative to the National Research Council, and Dr. E. J. Kraus, of the University of Chicago, is alternate representative.

The question of annual meetings during wartime was discussed, and it was voted that if sections F and G of the American Association for the Advancement of Science should organize national meetings, the Botanical Society of America would cooperate by participation in these meetings. It was further voted that if national meetings are not held for the duration of the war, then the society favors the organization of regional meetings for botanists, and recommends that such meetings shall be held when not in conflict with instructions from the Office of Defense Transportation.

SCIENTIFIC NOTES AND NEWS

DR. ROBERT A. COOKE was presented with a gold medal for "outstanding contributions to clinical allergy" at the sixth annual forum on allergy which was held at St. Louis on January 22 and 23. He delivered the fourth annual forum lecture entitled "Observations on Allergic Reaction."

THE General William E. Mitchell Memorial Award for 1943, sponsored by the *Aero Digest*, has been made to Igor I. Sikorsky, for "making the outstanding individual contribution to aviation progress" during the year 1943 in his development of the helicopter.

THE American Society of Heating and Ventilating Engineers presented at the fiftieth annual meeting of the society the F. Paul Anderson Medal to Lieutenant Commander F. C. Houghton, USNR, at a dinner on February 2 at the Hotel Pennsylvania, New York City. The award is in recognition of "outstanding research in heating, ventilating and air conditioning."

DR. JOHN ALEXANDER, professor of surgery at the University of Michigan, an authority on thoracic surgery, has been awarded the Henry Russel Lectureship. This award is given annually to the university faculty member adjudged by the Research Club of the university to have gained highest distinction in the field of scholarship. Dr. Alexander is the first faculty member to receive both the lectureship and the Henry Russel Award, the latter being given annually to a promising instructor or assistant professor. He was a recipient of the award in 1930, ten years after becoming instructor in surgery at the university.

THE officers elected for 1944 by the Union of American Biological Societies are: *President*, Dr. E. G. Butler, Princeton University; *Secretary*, Dr. F. A. Brown, Jr., Northwestern University; *Treasurer*, Dr. D. H. Wenrich, University of Pennsylvania. *Executive Committee:* Dr. A. P. Hitchens, University of Pennsylvania; Dr. J. F. Griggs, National Research Council, Washington, D. C.; Dr. M. Demerec, Carnegie Institution, Cold Spring Harbor.

DR. MORRIS A. STEWART, associate professor of entomology at the University of California at Berkeley, has been elected president of the Pacific Coast Entomological Society.

DR. H. W. RICKETT, of the New York Botanical Garden, who returned on November 1 from a four months' visit to Mexico, has been elected an honorary member of the Sociedad Botanica de Mexico, of which Professor Maximino Martinez, of the Instituto Politécnico in Mexico City, is president.

DR. HARLOW SHAPLEY, director of the Harvard College Observatory, has been elected a member of the board of trustees of the Kosciuszko Foundation of New York City. During the coming months the foundation will formulate plans to aid in the educational reconstruction of post-war Poland and in Polish-American relationship.

AT a meeting of the Council of the Royal Agricultural Society of England on December 15, Sir George Courthope, M.P., was elected president for 1944 in succession to Lord Mildmay of Flete, who has held office since 1941. The council decided to approach other agricultural bodies that had prepared reports on post-war policy with a view to common action in pressing the government for the earliest possible production of its post-war agricultural policy.

EDGAR H. BOLES, president of the General Reinsurance Corporation, has been elected president of the New York Post-Graduate Medical School and Hospital to succeed Dr. Arthur F. Chace. Dr. Chace, president of the New York Academy of Medicine, has served as president of the medical school and hospital for fourteen years.

DR. GEORGE LYNN CROSS, acting dean of the Graduate College of the University of Oklahoma, head of the departments of botany and bacteriology, has been named acting president of the university. He takes the place of Joseph A. Brandt, who became director of the University of Chicago Press on January 1.

DR. EARL B. SMITH, of the department of mechanical engineering of the College of the City of New York, and Dr. Alexander Marcus, of the department of physics, have been promoted to full professorships. Dr. Emil L. Post has been appointed associate professor of mathematics.

CHARLES HENRY SCHUMANN, of New York City, has been appointed to succeed the late William Griswold Smith as professor in engineering drawing and descriptive geometry for the Navy V-12 College Training Unit at Franklin and Marshall College, Lancaster, Pa. Since 1940 he has been head of the drafting department of the Defense Training Institute of the Engineering Colleges of Greater New York. Previously he had been head of the drafting department of Columbia University.

DR. L. F. THOMEN has been appointed Undersecretary of State for Health and Public Welfare of the Dominican Republic.

DR. H. D. DAWSON, for the past fourteen years head of the department of chemistry of Bethany College, W. Va., has resigned to accept a position with the Goodyear Rubber Company in the field of synthetic rubber. Dr. George W. Bennett, formerly head

of the department of chemistry at Washington and Jefferson College, has been made acting head of the department.

MAJOR GENERAL FOLLETT BRADLEY, U.S.A. (retired), formerly in command of the First Air Force at Mitchel Field and air inspector at the headquarters of the Army Air Forces at Washington, has been named assistant to the president of the Sperry Gyroscope Company.

ARTHUR T. PIENKOWSKY, until his retirement on January 1 physicist in charge of the testing of balances and weights at the National Bureau of Stanards, Washington, D. C., has joined the staff of the Torsion Balance Company and Christian Becker, in direct charge of research and control. Mr. Pienkowsky has been associated with the bureau for forty years.

FRANK C. WONDER, assistant taxidermist of the Chicago Museum of Natural History, has leave of absence, to work on the investigations of the Illinois State Natural History Survey on the migrations of ducks on the Illinois River.

W. H. CAMP, assistant curator at the New York Botanical Garden, who has been on leave of absence for two months in Central America and a year in Haiti, has returned.

DR. FRANK K. SCHOENFELD, technical superintendent of the division of chemistry of the B. F. Goodrich Company, Akron, Ohio, has become director of the division of technical research and development.

J. MORGAN JONES, registrar of the University College of Wales, Aberystwyth, who has been closely connected with the food production campaign in Wales, has been appointed Welsh secretary of the Ministry of Agriculture in succession to Dr. C. Bryner Jones.

IT is reported in *Nature* that the British Secretary of State for the Colonies has appointed N. F. Hall, director of the National Institute for Economic and Social Research, to be development adviser for West Africa. He will be on the staff of the resident minister and will act in close consultation with the Governments of Nigeria, the Gold Coast, Sierra Leone and the Gambia, which have been working for some time on plans for post-war development. Mr. Hall has been on leave of absence from the National Institute since 1938 for war work, and has served as joint-director of the Ministry of Economic Warfare. More recently he has been in charge of economic warfare work at the British Embassy, Washington, where he held the rank of minister in the diplomatic service.

AFTER an interval of four years the Royal Institution Christmas lectures, "adapted to a juvenile auditory," have been revived. The Christmas season's course of six lectures, which opened on December 28, as reported in *The Times*, London, had been unbroken until the present war broke out. The lecturer was Dr. E. N. da C. Andrade, Quain professor of physics in the University of London, and his subject was "Vibrations and Waves."

DR. S. A. WAKSMAN, microbiologist of the New Jersey Agricultural Experiment Station, will give at Syracuse University on February 18 an address before a joint meeting of Sigma Xi and the Syracuse section of the American Chemical Society entitled "The Production and Nature of Antibiotic Substances."

DR. RAYMOND JOHN SEEGER, associate professor of physics at the George Washington University, delivered on January 15 the address of the retiring president of the Philosophical Society of Washington. His subject was "Understanding Electric Breakdown in Solids."

THE twentieth Ludvig Hektoen Lecture of the Frank Billings Foundation, under the auspices of the Institute of Medicine of Chicago, will be given on March 24 by Dr. Shields Warren, of Boston. He will speak on "The Effects of Radiation on the Human Body."

THE Distinguished Service Award has been conferred by the Ordnance Department on the Society of Automotive Engineers "in recognition of outstanding and meritorious engineering advisory services in war and peace; in design, manufacture and maintenance of ordnance matériel."

APPLICATIONS to the Committee for Research in Problems of Sex of the National Research Council for financial aid during the fiscal year beginning on July 1, in support of work on fundamental problems of sex and reproduction, should be received before April 1. They may be addressed to the chairman, Dr. Robert M. Yerkes, Yale School of Medicine, New Haven 11, Conn. Although hormonal investigations continue to command the interest and support of the committee, preference, in accordance with current policy, will ordinarily be given to proposals for the investigation of neurological, psychobiological and behavioral problems of sex and reproduction.

THE American Society for Clinical Investigation will hold its annual meeting on May 8 at the Claridge Hotel, Atlantic City, N. J. This will be the thirty-sixth annual meeting.

A CONFERENCE of the Section of Physics and Chemistry of the New York Academy of Sciences will be held at the American Museum of Natural History on

Friday, February 11, and on Saturday, February 12, on "Energy Relationships in Enzyme Reactions." In addition to members of the academy, attendance is limited to those invited to participate.

LORD DE LA WARR, chairman of the British Agricultural Research Council and director of home flax production at the Ministry of Supply, is visiting Canada to speak throughout the Dominion on the war-time agricultural effort of the United Kingdom.

A PERMANENT collection of chemical compounds isolated from the tubercle bacillus, the only such collection in existence, was presented to Yale University by the National Tuberculosis Association on February 3. The collection, which is the result of seventeen years of research by Professor R. J. Anderson, of Yale, and his associates, will be presented by Dr. Lewis J. Moorman, president of the National Tuberculosis Association, and will be received by President Charles Seymour, of the university. The ceremony will be held in the Sterling Laboratory of Chemistry. Dr. William Charles White, chairman of the Committee on Medical Research of the National Tuberculosis Association, will speak on the work of his committee, which initiated the research in 1926 and which has supported the work since that time.

THIRTEEN bound volumes of the research bulletins of the Missouri Agricultural Experiment Station, with inscription on the outside front cover, "A token of friendship to our Russian allies from the citizens of Columbia, Missouri, U. S. A.," have been received by the National Council of American-Soviet Friendship from Dr. Henry E. Dent, dean of the Graduate School of the University of Missouri. These volumes have been handed over to the Soviet Embassy in Washington which will forward them to the chief of the Agricultural Library of the Lenin Academy of Agricultural Science, Moscow.

THE University of Rochester in cooperation with the Bausch and Lomb Optical Company, is offering a new scholarship plan designed to bring "outstanding science students to the university." Five scholarships, sponsored by the company, of the value of $500 each year for a term of three years, will be made available for competition beginning this year.

A DIAGNOSTIC and guidance clinic for inebriates will be opened at Yale University this month under the joint sponsorship of the Yale Laboratory of Applied Physiology and the Connecticut Prison Association. A similar clinic will also be opened in Hartford in the near future. Dr. Ralph Banay, psychiatric consultant of the New York State Parole Board, formerly chief psychiatrist of Sing-Sing Prison, will be the medical director and will supervise both the New Haven and Hartford clinics, with Dr. Clements C. Fry, psychiatrist, of the department of health of Yale University, as adviser. Dr. Banay will also participate in the routine clinical work. Dr. Anna Roe will be in charge of psychological testing, and Raymond G. McCarthy of social work. Dr. Howard W. Haggard, director of the Laboratory of Applied Physiology at the university, will have general charge of the clinic program.

DISCUSSION

AMORPHA FRUTICOSA CONTAINS NO ROTENONE

ROTENONE and related insecticidal compounds have been reported to occur in more than 70 species of plants,[1, 2] all of which are members of the family Leguminosae. In some cases rotenone or one of the rotenoids[3] has been isolated and characterized. In others a color test has been applied which has been taken as indicating the presence of this group of compounds. The test most frequently used is that of Durham.[4] The Gross-Smith test as modified by Goodhue[5] and the Rogers-Calamari test[6] also have been applied. Until recently these tests have been accepted as specific for rotenone and the rotenoids, especially when applied to leguminous plants. In 1942 Harper[7] showed that some synthetic furanoisoflavones also give a positive Durham test. These compounds, prepared from some of the rotenone derivatives, are insecticidally inert.

In 1937 Moore[8] concluded that rotenone was present in the roots, stem bark and seed of *Amorpha fruticosa* from Nebraska, because they gave a positive Durham test. In 1942 Featherly,[9] of the Oklahoma Agricultural and Mechanical College, suggested that, inasmuch as this plant is widely distributed throughout the Mississippi River Valley, its seed might serve as a source of rotenone during the war emergency. At his request seed from widely different locations were examined in the Bureau of Entomology and Plant Quar-

[1] H. A. Jones, *U. S. Bur. Ent. and Plant Quar.*, E-571, 14 pp., 1942. [Processed.]
[2] R. C. Roark, *Jour. Econ. Ent.*, 26: 587, 1933.
[3] R. C. Roark, *Jour. Econ. Ent.*, 33: 416, 1940.
[4] H. A. Jones and C. M. Smith, *Ind. Eng. Chem., Anal. Ed.*, 5: 75, 1933.
[5] L. D. Goodhue, *Jour. Assoc. Off. Agr. Chem.*, 19: 118, 1936.
[6] H. D. Rogers and J. A. Calamari, *Ind. Eng. Chem., Anal. Ed.*, 8: 135, 1936.
[7] S. H. Harper, *Jour. Chem. Soc.*, 1942, 595.
[8] R. H. Moore, *Puerto Rico Agr. Expt. Sta. Rept.*, 1937, 115 pp.
[9] *Agricultural Insecticide and Fungicide Assoc. Bul.* No. D-23, 2 pp., Oct. 7, 1942.

antine for their supposed rotenone content. Although all the samples gave a positive Durham test and Gross-Smith-Goodhue (G-S-G) test, no rotenone or any of the rotenoids could be isolated from any of them.

However, fractionation of the chloroform extractives of the seed collected at Vermillion, S. Dak., by the Soil Conservation Service yielded a compound that melted at 151–151.5° and gave a positive reaction in both the above mentioned tests. The name "amorphin" is proposed for the new compound. Analysis showed it to correspond to the formula $C_{33}H_{40}O_{16}$. The compound gave a positive orcin test but did not reduce Fehling's solution. When warmed in concentrated hydrochloric acid, the compound readily dissolved, and when further heated a product separated that after purification melted at 191–192°. Analysis showed it to correspond to the formula $C_{22}H_{22}O_7$. It also gave a positive reaction in both the Durham and the G-S-G test. The compound, tentatively designated "amorphigenin," also was obtained from the ether extractives of the seed. The acid filtrate obtained in the hydrolysis of amorphin readily reduced Fehling's solution.

It thus appears that *Amorpha fruticosa* contains a glycoside which, as well as its aglycone, behaves similarly to rotenone in certain color tests. Details of the experimental procedure will be published elsewhere.

FRED ACREE, JR.
MARTIN JACOBSON
H. L. HALLER

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE,
AGRICULTURAL RESEARCH ADMINISTRATION,
U. S. DEPARTMENT OF AGRICULTURE

POST-WAR PLANNING IN RUSSIA

ISSUE No. 20 of the *Astronomical Circulars* published by the Bureau of Astronomical Information of the Academy of Sciences of the U.S.S.R., dated August 13, 1943, contains an interesting plan by D. J. Martinov for the construction of a large southern astrophysical observatory. This plan was apparently presented at a conference of astronomers last September, together with reports by G. A. Shajn and I. A. Dukov on the development of astrophysics and positional astronomy in the U.S.S.R. The destruction of the Pulkovo Observatory has made it necessary to reconsider former plans, and it is now suggested that Pulkovo be reestablished as a center of positional work, together with the Engelhardt Observatory near Kasan, the Nikolaeff Observatory and the Tashkent Observatory. Astrophysical work, on the other hand, is to be largely transferred to a new powerful observatory for which the city of Simferopol in the Crimea has been suggested. This institution is to consist of a central office in or near Simferopol, and of three observing stations—a mountain station at an elevation of about 2,000 meters (presumably in the mountains south of Simferopol); a high-altitude station for solar research at 3,500 meters, and a southern station, possibly in Africa. The equipment is to consist of two 80-inch reflectors (at Simferopol and in Africa), one 120-inch reflector (at the mountain station), two 16-inch double astrographs, one 50-inch and one 30-inch Schmidt telescopes, solar towers similar to those of Mount Wilson, a nebular spectrograph, a coronagraph of the type of Lyot, two 30-inch refracting telescopes (the author says "two reconstructed Pulkovo refractors . . ." which suggests that these instruments were saved), and numerous accessory instruments.

The author recommends that many of these instruments be ordered abroad because

> there are foreign firms which have established reputations in this field and to duplicate their experience and skill at home would take too much time; the construction of such giant instruments as the 120-inch and 80-inch reflectors in this country (the U.S.S.R.) would take many years, while the firm of Warner and Swasey would undoubtedly carry out such a project rapidly and skilfully. Similarly, in the construction of measuring instruments there is no need to compete with the Gaertner Scientific Corporation, or in the construction of accurate clocks with the Shortt concern.

The staff of the new observatory is to consist of 60 to 70 trained astronomers. Since there are not now enough persons available with the required astrophysical experience, it is suggested that the existing universities in the U.S.S.R. at once begin the training of some 60 to 70 students in each organization. The plan provides for the completion of the equipment and the staffing of the observatory in about 1947. For the purpose of facilitating the training of the necessary staff, the author recommends that orders be placed at once abroad for the purchase of various instruments at a cost of two or three million rubles.

The breath-taking scope of this plan will probably startle those who have had little inclination during the past two years to indulge in post-war planning. It shows an extraordinary spirit among the scientific workers of the U.S.S.R., especially if we consider that the plan was prepared at a time when even the proposed site of the new observatory was still in the hands of the enemy. Perhaps it would be advantageous to the organizers of the astrophysical observatory in Russia if they would augment their plan by sending to the United States and to Great Britain a few of their best astrophysicists. These visitors could study the performance of various types of instruments and profit from the experience of existing observatories. They could also broaden the basis of their interests and secure adequate training in those

branches which have not previously been developed in Russia. Since it is generally recognized that Russian astrophysicists have obtained remarkable results in many fields of study the benefits of such an arrangement would be by no means one-sided and our own observatories would gain enormously from the contact.

O. STRUVE

YERKES OBSERVATORY,
WILLIAMS BAY, WIS.

IS TEACHING ABILITY RECOGNIZED?

LIKE a refrain one hears in current discussions of academic problems remarks like the following: "These objectives can be obtained only if the teaching ability of faculty members is given as much recognition as is given to research ability." "Teaching ability is not rewarded by our colleges as is research ability."

If some one does not soon question the accuracy of these statements they will come to be believed through mere repetition. The first time I ever heard the validity of such assertions openly and adequately challenged was during the meeting of the American Society of Agronomy at St. Louis in November, 1942. A session was being held on teaching and its problems. A guest speaker had repeated the time-worn remark that in our colleges teaching is not rewarded as is research. In the course of the discussion which followed Dr. H. K. Hayes, of Minnesota, offered the comment that teaching ability in that field was recognized and rewarded. He added that if necessary he could present the proof.

The discussion went on. As I was a visitor, only a few of the men present were known to me personally. It was, however, evident from the remarks that many of them were men of unquestioned eminence in their field. The group evidently included a good number of heads of large departments of agronomy and a sprinkling of deans of agriculture. Finally some one asked Professor Hayes for his proof. His reply, which I quote from memory, was somewhat as follows: "I have objective proof. It is here in this room. I do not wish to embarass anyone so I will not name individuals unless someone insists, but I see here a goodly number of individuals of recognized standing and influence in their fields whose positions rest on their recognized ability as teachers rather than as investigators." That ended the discussion.

One result of the discussion thus ended was that I started a survey of the teaching of botany in the United States during the past generation. Some portion of the material assembled will be published elsewhere. One of the conclusions to which I have come is a wholehearted agreement with Professor Hayes's spontaneous outburst at St. Louis. It makes little difference what objective criterion of eminence one chooses provided the list contains a fair number of names. A list of presidents of the Botanical Society of America will serve or a list of the presidents of any of the other societies concerned with plant science or the chairmen of Section G, or of those who have received the now much discussed "stars" in "American Men of Science." In any case one finds a large percentage of those who are known first and foremost as teachers. This is particularly impressive when it is realized how many of our colleagues have to give all their time to research or administration.

The same thing may not be true in fields other than those of the plant sciences. At least the question may fairly be raised regarding them. Of course I have no information as to the salaries received by these outstanding teachers; that seems to be the critical point, but it seems unlikely that they have been conspicuously less well paid than their fellows.

Apparently one source of the assertion so freely made that teaching ability as such is not adequately rewarded is the failure of those who make it to recognize that teaching ability may be coupled with other abilities. In other words, the mere fact that a member of a college faculty is unable or unwilling to carry out a research program does not constitute *prima facie* evidence of teaching ability of a high order.

NEIL E. STEVENS

UNIVERSITY OF ILLINOIS

SCIENTIFIC BOOKS

ERUPTIVE ROCKS

Eruptive Rocks, Their Genesis, Composition, and Classification, with a Chapter on Meteorites. By S. JAMES SHAND. Second edition. New York: John Wiley and Sons. London: Thomas Murby and Company, 1943. Pp. xvi + 444; figs. 47, pls. 3. $5.00.

THIS second edition of Professor Shand's notable book has been extensively revised. The wide field and laboratory experience of the author and his many contacts with the points of view of petrologists of three continents, as a student in Scotland and as a teacher in South Africa and America, give him an unusually comprehensive grasp of the subject. This has resulted in a book which gives the best elementary treatment of the eruptive rocks that is in print. The author has a wide familiarity with the literature and lists many references at the end of each chapter. Throughout, the discussions are brief and critical, and they preserve an excellent balance between the field,

the laboratory, and the geochemical data and arguments.

The first chapter deals with such properties of magmas as their fluidity, water content and temperatures of consolidation. For the latter he boldly places the temperature of consolidation of extrusive rocks above 700° and those of most granular rocks from 700° to 500°. These temperatures are probably lower than would be given by most petrographers. At the time the quartz of the pegmatites was studied all the pegmatites were thought to be magmatic, but our present knowledge indicates that all the low quartz tested from pegmatites was hydrothermal and all the magmatic quartz was high quartz. There is no convincing evidence that the temperature of crystallization of the extrusive rocks is much, if any, higher than that of the granular rocks with the same composition.

The second chapter deals with the minerals and mineral families in the eruptive rocks and the relative abundance of the oxides and elements. The descriptions of the mineral families deal chiefly with their chemical compositions and artificial formation. It recognizes the complexity of the rock minerals and explains this on the modern theory of atomic substitution. The descriptions are brief, but they are clear and accurate and so are suitable for an elementary student.

Chapter 3 deals with the fugative constituents and is a well-balanced discussion of the field, laboratory and geochemical data.

Chapter 4 discusses the temperature and pressure in the magma. The discussion is excellent. However, the reviewer has concluded both from a study of the literature and from personal observations that inversion of quartz to tridymite by magmatic heat is very rare, and we still need clear evidence that it takes place. The data on the effect of pressure on the high-to-low-quartz inversion are accurately known. The curve of Goldschmidt on the effect of pressure on the reaction $CaCO_3 + SiO_2 \rightleftarrows CaSiO_3 + CO_2$ has little value as the pressure involved is the vapor pressure of CO_2 and this may be low since the CO_2 escapes as the reaction takes place.

Chapter 5 on the freezing of the magma presents chiefly the psysico-chemical data. Chapter 6 on the magma and its walls places reasonable emphasis on reaction and assimilation by the magma. Chapter 7 on the order of crystallization fails to give sufficient emphasis to the natural chilling experiments prepared for us by nature in the lavas and small intrusive bodies. Chapter 8 deals with compatible and uncompatible phases and Chapter 9 with eruptive rock complexes.

The next ten chapters deal with the classification and description of rocks and with problems that concern chiefly one group of rocks. After a general discussion of rock classification, the author presents his own system. The major divisions are based on the rather obvious and commonly used silica content—oversaturation, saturation, or undersaturation. The next subdivision is based on the alumina content with respect to that required to form feldspars and feldspathoids. Does a broad study of rocks justify such great importance being given to alumina? Next are four divisions depending on the proportion of dark minerals. Then four divisions based on the proportion of the different feldspars or feldspathiods: or $>$ an and or $>$ ab; or $>$ an and or $<$ ab; or $<$ an and ab $>$ an; and or $<$ an and ab $<$ an.

Shand's system of classification seems to differ materially in many respects from that in common use, yet rock names are used by Shand with much the same meaning as in other systems.

Shand's book is very well written. It does not present the material dogmatically but gives the arguments pro and con clearly and concisely. The reader is shown the complexities and uncertainties that are inherent in nearly all petrological problems.

The repeated use of the terms acid and basic rather than silicic or some other more appropriate terms and the use of alkaline for alkalic will be unwelcome to many American petrographers who have been attempting to discourage the use of these inappropriate terms.

The philosophical quotations at the beginning of each chapter are apt.

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CHEMISTRY

Chemistry Made Easy. By CORNELIA T. SNELL and FOSTER DEE SNELL. D. Van Nostrand Company, Inc., New York. 1943. 4 vols. $7.95.

IN four small volumes this collection runs the gamut of introductory chemistry: theoretical inorganic (184 pp.), descriptive inorganic (232 pp.), organic (256 pp.) and industrial chemicals (542 pp.).

As for the first two volumes, the part-time scientist may prefer their easy style to the pedantry of most general chemistry text-books, and certainly will welcome the interesting bits of industrial information which reflect the authors' close association with chemical industry. Unfortunately, theory is sketchy and occasionally incorrect; and a sound perspective of the family relationships of the elements is lacking. For example, the cart seems before the horse in the statement (II, 12) that H_2F_2 is written as a dimer because it forms acid salts, rather than writing that its molecular weight so indicates; or that (I, 98) "the essential characteristic of an element (in forming com-

pounds) is the number of free protons in the nucleus, rather than the number of planetary electrons." The chapters on radioctivity and colloids are brief and inadequate. Polonium, not radium (II, 206), was "the first radioactive element to be discovered"; and the Great Bear Lake deposits, rather than Colorado carnotite, deserve mention. Also, in attempting to make chemistry easy the authors have omitted such difficult but important topics as chemical equilibrium, energy in chemical reactions, determination of atomic and molectular weights and a thorough treatment of ionization. There are three chapters on pH, including colorimetric and electrometric methods for determining pH; nevertheless their excellent treatment justifies the inordinate space, one tenth of Volume I, allocated to it. To lower costs, pictures and portraits are omitted.

The concluding two volumes are vastly better. The beginner will find Volume III an unusually good brief on aliphatic and aromatic compounds, and I can recommend it enthusiastically. The descriptive matter is carefully organized and intelligently presented. Volume IV is a reprinting of "Chemicals of Commerce," the valuable reference book which has already reserved a niche for itself on the shelves of important chemical literature.

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SPECIAL ARTICLES

A NOTE ON ASCORBIC ACID: NITROGEN RELATIONSHIPS IN GRAPEFRUIT

PHYSIOLOGICAL studies of the yield, quality and maturity of Marsh grapefruit in Arizona carried on by the Department of Horticulture of the Arizona Agricultural Experiment Station[1] have revealed certain influences of seasonal nitrogen supply. Grapefruit from trees having a high nitrogen nutrition throughout the year, as determined by foliar analyses, have been found to be less sweet, to color later, be thicker-skinned, poorer-shaped and to be of lower market grade than fruit from trees having a declining nitrogen content through the period of fruit growth and maturity.

Since the importance of grapefruit lies chiefly in its nutritive value, especially its vitamin C content, it seemed desirable to investigate the relationship of the ascorbic acid content of the fruit to the nitrogen nutrition of the tree.

Accordingly, five representative fruits picked from the north, south, east, west and center of four grapefruit trees from a high nitrogen experimental plot and four grapefruit trees from a low nitrogen experimental plot at the university orchard, Yuma, Arizona, were harvested at weekly or bi-weekly intervals beginning September 28, 1942, continuing until January 31, 1943. The fruit was shipped to the Department of Human Nutrition, of the Arizona Agricultural Experiment Station in Tucson. A total of 540 of these Marsh grapefruit were analyzed separately for their volume of juice, pH, total acidity, Brix: acid ratio, and ascorbic acid content. The ascorbic acid assays were made following the method of S. A. Morell. The bleaching effect of ascorbic acid on 2–6 dichlorobenzenone indophenol was measured in the Evelyn photoelectric colorimeter, correction being made for turbidity and other interfering pigments.

Analyses were carried on in a similar fashion with Marsh grapefruit from the Phoenix, Ariz., area. Data were found to agree with those shown in Table I for Marsh grapefruit from Yuma.

TABLE I

ASCORBIC ACID CONTENT OF MARSH GRAPEFRUIT JUICE (YUMA) AS RELATED TO NITROGEN NUTRITION OF THE TREE

Date of Analysis	Low nitrogen nutrition					High nitrogen nutrition				
	Tree 3	Tree 33	Tree 4	Tree 44	Ave.	Tree 5	Tree 55	Tree 6	Tree 66	Ave.
	Ascorbic acid content mg/ml*					Ascorbic acid content mg/ml				
9/30/42	.56	.53	.59	.53	.55	.48	.46	.41	.43	.45
10/ 7/42	.50	.49	.49	.47	.49	.46	.43	.38	.39	.42
10/13/42	.51	.51	.50	.45	.49	.42	.43	.42	.40	.42
10/21/42	.49	.47	.48	..	.48	.41	.44	.39	.35	.40
10/27/42	.48	.47	.46	.47	.47	.43	.40	.35	.33	.38
11/ 3/42	.50	.45	.50	.42	.47	.38	.41	.35	.31	.36
11/10/42	.45	.41	.50	.45	.45	.40	.38	.33	.33	.36
11/17/42	.48	.43	.48	.47	.47	.37	.42	.36	.34	.37
11/24/42	.50	.46	.47	.44	.47	.40	.42	.36	.34	.38
12/ 9/42	.44	.43	.41	.40	.42	.38	.41	.36	.36	.38
12/20/42	.47	.43	..	..	.45	..	..	.36	.34	.35
1/ 5/43	.48	.46	..	..	.47	..	..	.34	.37	.36
1/19/43	.46	.40	.41	.38	.41	.39	.37	.35	.34	.36
2/ 2/43	.43	.42	.44	.38	.42	.36	.36	.33	.33	.35
Average	.48	.45	.48	.44	.47	.41	.41	.36	.35	.38

* Average of 5 fruits from each tree.

It is consistently evident that the fruit from trees handled to give a low nitrogen content at harvest are higher (approximately 20 to 25 per cent.) in ascorbic acid content than those from trees in which a higher nitrogen plane prevailed. Differences of the same order were observed at each date of harvest throughout the season.

In order to gain more evidence in support of these data, studies were conducted in the present season in which both nitrogen and ascorbic acid determinations were made on grapefruit juices. These analyses were made by the Horticulture Department; ascorbic acid by visual titration with 2–6 dichlorobenzenone indophenol and nitrogen by the micro-Kjeldahl method.

[1] William E. Martin, *Univ. Ariz. Tech. Bull.*, 97, 1942.

The results of analyses of four composited samples of representative fruit from each of fifteen different trees from three experimental plots in Yuma are shown in Fig. 1.

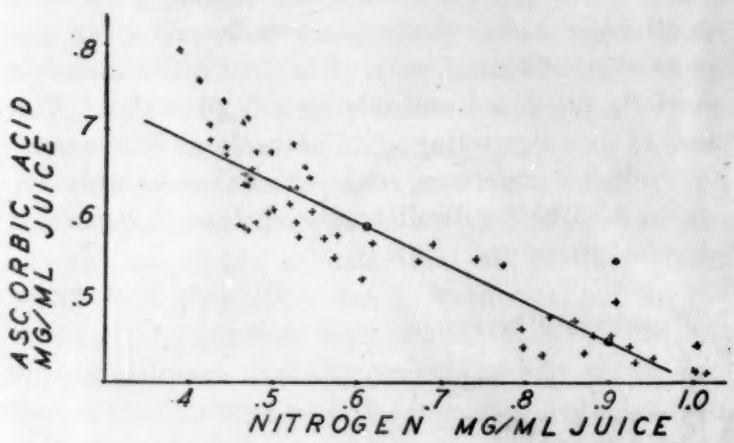

FIG. 1. Regression of ascorbic acid on nitrogen in grapefruit juice.

The data of the figure show a negative correlation coefficient of 0.91 between the nitrogen and ascorbic acid content of the juice of the grapefruit. Just why this relation between nitrogen and ascorbic acid exists in citrus juice is not clear.

As far as we are aware the high values for ascorbic acid are higher than any reported for grapefruit juice. At the same time, however, the nitrogen values are extremely low for those samples that show a high ascorbic acid content.

Perhaps it is associated with the ascorbic acid—oxidase respiratory system as described by Szent-Györgyi.[2]

It would be of interest to know if this relation between ascorbic acid and nitrogen, which has been found in Arizona grapefruit, holds for other citrus-producing areas and for other fruits or vegetables.

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THIOUREA AND RESISTANCE TO LOW ATMOSPHERIC PRESSURES ("HIGH ALTITUDES")*

IT has been reported that thyroidectomized rats are better able to tolerate exposures to anoxia and reduced atmospheric pressures[1, 2, 3] than normal animals. Administration of thyroid and injections of anterior pituitary substance have been found to increase the sensitivity of animals to oxygen lack.[1, 2, 4, 5]

Mackenzie and Mackenzie[6] and Astwood *et al.*[7] have shown recently that treatment of rats with thiourea and the sulfonamides results in the development of a state of functional hypothyroidism, characterized by an enlarged, hyperplastic thyroid gland and a drop in the B.M.R. Withdrawal of the drugs results in a return of the animal to a normal condition.[7] The administration of thiouracil to the human suffering from hyperthyroidism results in a reduction of the basal metabolic rate.[8, 9] It has been demonstrated that thiourea produces these effects by interfering with the production of normal thyroid hormone by the thyroid gland.[10]

In view of these results it became of interest to test the effects of thiourea upon the resistance of animals to low atmospheric pressures. One hundred and two adult female rats were employed in these experiments. Thirty-six of these were fed a diet containing 0.5 per cent. thiourea for periods of time varying from 4 to 30 days. Thirty others were injected with 200 mg of thiourea in distilled water 5 hours prior to initiation of the low pressure treatment. Thirty-six animals served as untreated controls. All animals were then exposed to pressures of 200 mm Hg (32,000 feet), for 2 hours in a specially constructed low pres-

TABLE 1

EFFECT OF THIOUREA ON RESISTANCE TO LOW ATMOSPHERIC PRESSURES

Days on thiourea	No. of animals	Percentage mortality	Mean thyroid weight (mg)
0 (Controls) ..	36	75	14.0
0 (Thiourea injections)	30	60	13.9
4–8	18	50	18.0
12	6	0	29.3
14	6	0	30.0
30	6	0	37.4

[1] H. Streuli, *Biochem. Ztschr.*, 86: 357, 1918.
[2] M. Duran, *Biochem. Ztschr.*, 106: 254, 1920.
[3] A. L. Barach, M. Eckman and N. Molomut, *Am. Jour. Med. Sci.*, 202: 336, 1941.
[4] B. Houssay and C. Rietti, *Compt. Rend. Soc. de Biol.*, 110: 144, 1932.
[5] J. A. Campbell, *Quart. Jour. Exp. Physiol.*, 24: 271, 1935.
[6] C. G. Mackenzie and J. B. Mackenzie, *Endocrinology*, 32: 185, 1943.
[7] E. B. Astwood, J. Sullivan, A. Bissell and R. Tyslowitz, *Endocrinology*, 32: 210, 1943.
[8] E. B. Astwood, *Jour. Am. Med. Asn.*, 122: 78, 1943.
[9] R. H. Williams and G. W. Bissell, SCIENCE, 98: 156, 1943.
[10] A. S. Keston, E. D. Goldsmith, A. S. Gordon and H. A. Charipper, *Jour. Biol. Chem.*, in press.

[2] A. V. Szent-Györgyi, "On Oxidation, etc." Williams and Wilkins Co., Baltimore, 1939.

* This investigation was supported by a grant from The Commonwealth Fund.

sure chamber.[11] At the end of this period, the mortality percentages were recorded and the thyroid glands of all animals were dissected and weighed. The results are shown in Table 1.

The data indicate that treatment with thiourea for 12 or more days enables the rats to survive a reduction of the atmospheric pressure to 200 mm of Hg, whereas the majority of the untreated controls succumb. Thiourea injections made a short time (5 hours) prior to exposure to low pressures have no apparent beneficial effect. Preliminary experiments performed with males have shown that these are also benefited by thiourea provided the treatment is applied for at least 12 to 14 days. It is to be observed that the animals on a thiourea ration for 12 or more days possess heavier thyroids than do the untreated rats or those given the drug for shorter periods of time. This enlargement of the thyroid gland, a condition which is readily reversible when thiourea is withdrawn, is indicative of the development of a hypothyroid condition.[6,7] We are of the opinion that this state of functional hypothyroidism (chemical thyroidectomy) is responsible for the increased tolerance to reduced atmospheric pressures shown by rats treated with thiourea.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW METHOD FOR PRESERVATION OF HUMAN AND ANIMAL TISSUES BY THE USE OF A TRANSPARENT PLASTIC

A GOOD preservation of form of human and animal organs can be obtained by imbedding them in a transparent plastic, "Plexiglas." A method for imbedding insects and similar structures in "Plexiglas" has been proposed by Dr. Charles Sando,[1] but this procedure could not be applied successfully to fleshy animals or organs of animals and humans without considerable loss of form and color. The present process has been used so far in the case of relatively small organs (approximately $8 \times 5 \times 5$ cm) and to slices of larger organs ($10 \times 10 \times 2$ cm). There appears to be, however, no difficulty in applying the method to considerably larger objects.

The advantages of this method of tissue preservation are: (1) the remarkable preservation of size, shape and texture and the satisfactory retention of color; (2) the ease of handling of the finished specimen, which is permanent and practically unbreakable; (3) the avoidance of distortion of vision due to the curvature of the surface of containers and the preserving fluids generally employed.

Preliminary to the imbedding, it is necessary to dehydrate the tissue. This is accomplished by placing the fresh organ or piece of tissue on a layer of frozen water (5 to 10 mm in thickness) contained in a suitable receptacle, and cooled to $-20°$ C. or below, by covering the organ with cold distilled water and freezing the whole mass as rapidly as possible at a temperature of $-20°$ C. or below. The mass of ice without and within the organ is then removed by condensation of water vapor at low temperature *in vacuo*.[2] The tissues thus obtained are very light and porous and appear to have lost a great deal of the color and texture. At this point the specimen may be readily trimmed with a sharp scalpel. The dried tissues should be promptly sealed or processed so as to avoid absorption of moisture. They should be carefully brushed with a camel's hair brush, to remove any loose particles or dust and similar foreign material.

The next step in the process is the saturation of this tissue with the liquid acrylic ester (monomeric ethyl methacrylate).[3] This is attained by pouring the ethyl methacrylate in a large-mouthed receptacle, placing the tissue in it and then producing a vacuum (about 700 mm of Hg.). This is easily accomplished by setting the open receptacle containing the specimen in a vacuum-desiccating jar with stout walls. In a period of one half hour to one hour, the air will be entirely replaced by the ethyl methacrylate, and upon readmitting air into the jar, the tissue will sink in the fluid. In the case of highly porous materials, it may be necessary to repeat this vacuum treatment several times before all trapped air has been replaced by the monomer. The colors of the tissue appear to have returned, but they are somewhat duller than normal and the natural texture is still lacking at this point of the process.

The subsequent steps have to deal with the imbedding of the tissue by polymerization of the monomer. In view of the fact that prolonged immersion of the tissue in the liquid ethyl methacrylate causes bleaching, it is desirable to hasten the polymerization by the addition of a catalyst, such as benzoyl peroxide, and

[11] M. Dubin, *Quart. Jour. Exp. Physiol.*, 24: 31, 1933.
[1] H. G. Knight, SCIENCE, 86: 333, 1937.

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[2] Max M. Strumia and John J. McGraw, *Jour. of Lab. and Clin. Med.*, 28: 9, 1140–1155, June, 1943.
[3] Obtained from Rohm and Haas Company, Philadelphia 5, Pa.

by cautious use of heat. The simplest technic may be summarized as follows:

(1) Dissolve benzoyl peroxide in ethyl methacrylate, in the proportion of .2–.3 per cent.

(2) After adding a porous clear boiling chip, bring a sufficient amount of this mixture to boil over a hot plate. Avoid an open flame, as the material is inflammable. Boil the material (approximately 115° C.) for about one minute and then cool immediately with running water to about 50° C. Polymerization is an intensely exothermic reaction, and cooling must be done rapidly, otherwise the heat production will be so intense as to cause boiling over and solidification in the form of an opaque mass. Allow the ethyl methacrylate to remain in a closed receptacle (avoid rubber) at plus 50° C. until complete solidification is obtained. About 20 per cent. shrinkage in the volume of the material occurs during polymerization and allowance must be made for this loss.

(3) Remove the piece of tissue saturated with ethyl methacrylate from the liquid monomer, place it upon the base of "Plexiglas" thus prepared, and immediately cover with the ethyl methacrylate-benzoyl peroxide mixture which has been polymerized previously to a syrupy consistency. Polymerization to syrupy consistency is accomplished exactly as outlined under 1 and 2, but the process is stopped when the proper viscosity is obtained. The trapping of air bubbles during this procedure should be carefully avoided. If this occurs, remove by means of a vacuum in a desiccator as previously outlined.

(4) Close the container and place at about 50° C. and allow polymerization to proceed until the mass is thoroughly solid. Polymerization occurs more rapidly at higher temperatures, and more heat may be applied gradually until a temperature of about 70° C. is reached in two to three days. It is desirable, when polymerizing at temperatures higher than 40–50° C., to reduce the height of the layer of the liquid monomer to about 10 mm. Successive layers may be added as desired.

(5) The glass receptacle is then broken and the mass of solidified acrylic resin containing the imbedded tissue is removed. The block is generally clear enough for viewing the specimen without further work. It may, however, be readily cut and polished so as to obtain a more finished product. For large flat slices of organs, a form can easily be obtained by properly binding plates of thick glass with parchment paper.

Any object made by casting an acrylic resin may "craze" unless it is given an annealing treatment. This "crazing" is seen initially as an iridescent effect on the surface of the material and may eventually result in a network of fine cracks extending some distance into the solid mass. In order to prevent "crazing," after any cast object has been machined to the approximate finished shape, we recommend that it be subjected to a temperature of 100–115° C. for one-half hour.

The organs thus imbedded have the original size and shape and retain the normal texture to a remarkable degree. The color is somewhat less brilliant than it was originally, but if the period of polymerization is not too long, it may be satisfactorily preserved. The color has been found to be permanent in mounted specimens even on continuous exposure to sunlight for several months.

Fatty tissues are not so suitable for this type of imbedding. Some organs, such as the liver, have a tendency to release pigment, which causes the imbedding mass to have a slight discoloration. This does not seem, however, to interfere with the general appearance and preservation of the specimen. If the tissue is thin, a certain degree of transparency is attained, which in many cases is desirable.

This process offers what appears to be a most promising method of preservation of normal and pathological specimens for teaching and museum purposes.

Further studies on this procedure are in progress. For the present, the method outlined appears most applicable for the preservation, without shrinkage or loss of color and texture, of small organs, embryos, little animals, fleshy insects and tissues with delicate structure.

We are indebted to Dr. D. S. Frederick, Dr. H. T. Neher and Mr. Hiltner of the Rohm and Haas Company for their helpful assistance in carrying out this work.

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BOOKS RECEIVED

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Estadistica. Pp. 192. Inter-American Statistical Institute. 60¢.

EYRING, HENRY, JOHN WALTER and GEORGE E. KIMBALL. *Quantum Chemistry.* Illustrated. Pp. vi + 394. John Wiley and Sons. $5.00.

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